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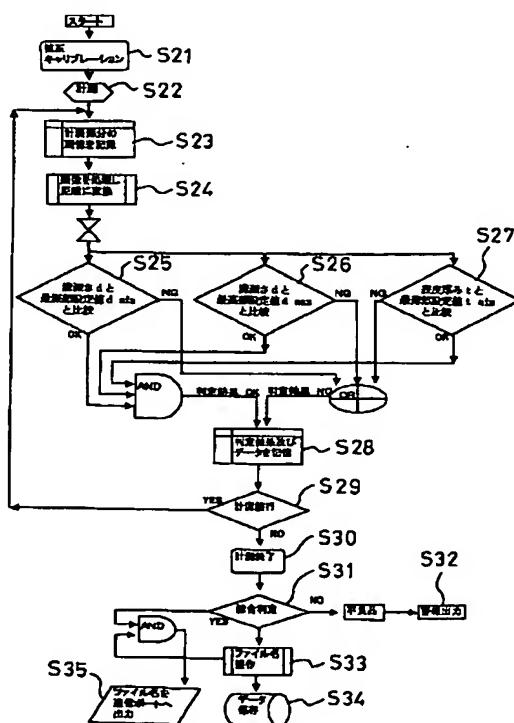
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(54)【発明の名称】溝深さ計測記録方法及びそのシステム

(57)【要約】

【課題】 線状溝底部の残存厚みを溝加工に並行して能率よく計測できるだけでなく、線状溝が多少蛇行していくても、溝最深部に対応する残存厚みを確実かつ高精度に計測し記録して適確な品質管理に役立てることができるようとする。

【解決手段】 樹脂製表皮の表面に切り込み加工された線状溝にその開口部側からレーザ光を照射しその反射光をCCDが備えている多数の受光素子で受光出力させることにより所定幅を持つ反射画像を作成し、この反射画像の画像処理により所定幅の中で最も小さな値を溝最深部の値として算出し、この算出された溝最深部の値が許容設定範囲内にあるか否かを判定しそれらの判定結果がOKの場合のみ溝最深部の値から残存厚みを演算出力し、かつ、記録するようにしている。



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## 【特許請求の範囲】

【請求項1】 シート状ワークの表面に切り込み加工された線状溝の深さを計測し、その計測値からシート状ワークにおける線状溝底部の残存厚みを演算出力し記録する方法であって、

裏面が平坦面に密着するように固定保持されたシート状ワーク表面の線状溝に開口部側から溝底部に向けてのレーザ光を照射するとともに、その反射光を線状溝の長手方向に直交する方向に等しい間隔で多数の受光素子を有するCCDで受信して多数の微小面積が集合した所定幅の反射画像を作成し、

このCCDにより作成された反射画像を画像処理することにより、所定幅の中で最も小さな値を溝最深部の値として算出した後、

その算出された溝最深部値が予め設定された許容範囲内にあるか否かを判定し、

その判定において、上記算出溝最深部値が設定許容範囲内にあるとの判定結果が出た場合、算出溝最深部値から残存厚みを演算出力するとともに、その出力値を記録することを特徴とする溝深さ計測記録方法。

【請求項2】 対象とするシート状ワークが、エアバック設置箇所に対応する部分に所定の肉厚を残存させる状態で線状溝を切り込み加工する自動車用樹脂製表皮である請求項1に記載の溝深さ計測記録方法。

【請求項3】 シート状ワークの表面に切り込み加工された線状溝の深さを計測し、その計測値からシート状ワークにおける線状溝底部の残存厚みを演算出力し記録するシステムであって、

シート状ワークをその裏面が平坦面に密着するように固定保持する定盤と、

シート状ワーク表面の線状溝の開口部側からレーザ光を照射するとともに、その反射光を線状溝の長手方向に直交する方向に等しい間隔で配置された多数の受光素子で受光することにより微小面積が集合した所定幅の反射画像を作成するCCDと、

このCCDにより作成された反射画像の画像処理により、所定幅の中で最も小さな値を溝最深部の値として算出する手段と、

その算出された溝最深部値が予め設定された許容範囲内にあるか否かを判定する判定手段と、

この判定手段において、上記算出溝最深部値が設定許容範囲内にあるとの判定結果が出た場合、上記算出溝最深部値から残存厚みを演算出力するとともに、その出力値を記録する手段とを、具備していることを特徴とする溝深さ計測記録システム。

【請求項4】 上記CCDにおける受光素子数は、手動で調整可能に構成されている請求項1に記載の溝深さ計測記録システム。

【請求項5】 対象とするシート状ワークが、エアバック設置箇所に対応する部分に所定の肉厚を残存させる状

態で線状溝を切り込み加工する自動車用樹脂製表皮である請求項3または4に記載の溝深さ計測記録システム。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】本発明は、主として自動車用インスツルメントパネルを形成するところの塩化ビニール(PVC)やポリオレフィン(TPO)、ポリウレタン(TPU)等の樹脂製表皮のエアバック設置箇所に対応する部分に、一定以上の破壊力が加わったとき、その箇所に応力を集中させて確実に破断しエアバックの適正な展開を可能とする線状溝のように、シート状ワークの所定箇所に切り込み加工された線状溝の深さを計測して、その計測値からシート状ワークにおける線状溝底部の残存厚みを計測し記録する方法及びそのシステムに関するものである。

## 【0002】

【従来の技術】シート状ワークに線状溝を切り込み加工して生産される製品においては、その製品品質を適正に管理する上で線状溝底部の残存厚みを計測して製品毎の

データとして記録し保存しておくことが重要である。特に、自動車用樹脂製表皮のエアバック設置箇所に対応する部分に加工される線状溝は搭乗者の安全性に密接に関与するものであることから、一定の破壊抵抗を持つ線状溝底部を再現性よく加工するためにも線状溝底部の残存厚みを精度よく計測して製品毎のデータを記録し保存しておくことが非常に重要である。

【0003】従来一般には、シート状ワークの表面側に切り込み加工された線状溝の開口部側から溝底部に向けて光を照射してワーク裏面側への透過光量を計測することにより残存厚みを計測する手段が採用されていた。

## 【0004】

【発明が解決しようとする課題】しかしながら、上記のごとき光透過型の計測手段では、溝がその長手方向に沿って許容範囲内で蛇行して加工されているような場合、光の照射位置を常に溝最深部に特定することが難しくて照射位置が最深部から離れやすいため、ワークの材質変化によっても透過光量が大きく変動しやすいため、残存厚みの計測値に誤差を生じやすく、適確な品質管理を行なうことができない。

【0005】また、光透過型の計測手段の場合は、投光部と受光部とをシート状ワークの表裏両側に各別に配置することが必要であるために、加工対象であるシート状ワークを定盤などの平坦面に密着固定して溝加工を行なう溝加工装置側の一方向に計測装置を配置することができず、溝加工箇所とは離れた箇所で計測するか、もしくは、溝加工工程とは分離された別の工程で計測することが必要となり、装置的に複雑になりやすいとともに工程が多くなり、生産性が悪化するという問題があった。

【0006】本発明は上記実情に鑑みてなされたもので、線状溝底部の残存厚みを溝加工に並行して能率よく

計測することができるだけでなく、線状溝が多少蛇行して加工されていても、溝最深部に対応する残存厚みを確実かつ高精度に計測しきつ記録して適確な品質管理に役立てることができる溝深さ計測記録方法及びそのシステムを提供することを目的としている。

### 【0007】

【課題を解決するための手段】上記目的を達成するために、本発明に係る溝深さ計測記録方法は、シート状ワークの表面に切り込み加工された線状溝の深さを計測し、その計測値からシート状ワークにおける線状溝底部の残存厚みを演算出力し記録する方法であって、裏面が平坦面に密着するように固定保持されたシート状ワーク表面の線状溝に開口部側から溝底部に向けてのレーザ光を照射するとともに、その反射光を線状溝の長手方向に直交する方向に等しい間隔で多数の受光素子を有するCCDで受信して多数の微小面積が集合した所定幅の反射画像を作成し、このCCDにより作成された反射画像を画像処理することにより、所定幅の中で最も小さな値を溝最深部の値として算出した後、その算出された溝最深部値が予め設定された許容範囲内にあるか否かを判定し、その判定において、上記算出溝最深部値が設定許容範囲内にあるとの判定結果が出た場合、算出溝最深部値から残存厚みを演算出力するとともに、その出力値を記録することを特徴とするものである。

【0008】また、本発明に係る溝深さ計測記録システムは、シート状ワークの表面に切り込み加工された線状溝の深さを計測し、その計測値からシート状ワークにおける線状溝底部の残存厚みを演算出力し記録するシステムであって、シート状ワークをその裏面が平坦面に密着するように固定保持する定盤と、シート状ワーク表面の線状溝の開口部側からレーザ光を照射するとともに、その反射光を線状溝の長手方向に直交する方向に等しい間隔で配置された多数の受光素子で受光することにより微小面積が集合した所定幅の反射画像を作成するCCDと、このCCDにより作成された反射画像の画像処理により、所定幅の中で最も小さな値を溝最深部の値として算出する手段と、その算出された溝最深部値が予め設定された許容範囲内にあるか否かを判定する判定手段と、この判定手段において、上記算出溝最深部値が設定許容範囲内にあるとの判定結果が出た場合、上記算出溝最深部値から残存厚みを演算出力するとともに、その出力値を記録する手段とを、具備していることを特徴とするものである。

【0009】上記のごとき構成要件を有する本発明によれば、裏面が平坦面に密着するように固定保持されてシート状ワーク表面に切り込み加工された線状溝の溝開口部側からレーザ光を照射してその反射光をCCDの多数の受光素子で受光させることによって、等しい微小面積（画素）が集合した所定幅の反射画像が作成されることになる。このように所定幅に作成された反射画像の画像

処理により所定幅の中で最も小さな値を溝最深部の値として算出することで、線状溝が許容される範囲内で多少蛇行状態に加工されていたとしても、溝最深部の値をミスなく確実に計測することが可能である。また、計測された溝最深部の値が予め設定された許容範囲内にあるか否かを判定し、その判定結果がOKの場合にのみ残存厚みを演算し出力して記録することによって、シート状ワーク自体の材質に関係なく、溝最深部に対応する残存厚みを精度よく計測し記録することが可能であり、その記録データを次に線状溝を再現性よく加工するためのフィードバック資料に利用することで、製品全体の品質管理を適確に行なうことが可能である。

【0010】また、レーザ光の反射光を受信するものであって、投光部も受光部もシート状ワーク表面側に配置して一方向からの計測が可能であるから、シート状ワークの裏面を定盤などの平坦面に密着固定させて表面に溝を加工する溝加工装置側に計測装置の全体を近接配置し溝加工と並行して溝深さを計測することが可能となり、溝加工及び加工溝深さの計測を一連の工程で能率よく行なえ、製品の生産性向上も図ることができる。

【0011】上記した本発明に係る溝深さ計測記録システムにおいて、CCDにおける受光素子数、すなわち、画素数を、請求項4に記載のように、手動で調整可能に構成する場合は、画像を見ながらその画像に山や谷の部分があるとき、画素数を減少（絞る）する方向に調整することによって、山や谷部分の計測を排除することができる。

【0012】また、本発明に係る溝深さ計測記録及びそのシステムが対象とするシート状ワークは、表面に線状溝が加工されたシート状のものであればなにであってもよいが、請求項2及び請求項5に記載したように、エアバッグ設置箇所に対応する部分に所定の肉厚を残存させる状態で線状溝が切り込み加工されている自動車用樹脂製表皮を対象とする場合に特に有効である。この自動車用樹脂製表皮を対象とする場合は、エアバッグの展開性能という自動車の搭乗者の安全性確保の面から非常に小さい誤差範囲内で加工されていることが要求される線状溝の加工深さを正確に計測し記録することができ、再現性よい溝加工を行なうためのフィードバック資料の作成に有効に活用することができる。

### 【0013】

【発明の実施の形態】以下、本発明の実施の形態を図面にもとづいて説明する。図1は自動車用樹脂製表皮を対象シート状ワークとして本発明方法を実施する際に用いられる溝深さ計測記録システムの概略構成図である。同図において、1はその裏面が定盤2の平坦上面2aに密着するように載置された自動車用樹脂製表皮であり、その表面でエアバッグ設置箇所に対応する部分には、例えば超音波加工装置やレーザ加工装置、あるいは高周波加

工装置等の各種の溝加工装置（図示省略する）によって、その底部に所定厚み  $t$  の肉厚を残存させる状態で線状溝3が切り込み加工されている。

【0014】4は上記樹脂製表皮1の表面の上方部に設置されたレーザ正反射CCD変位センサであって、これは溝加工装置と一体的に移動するよう設置されている。5はそのレーザ正反射CCD変位センサ4のCCD受信画像をNTSC方式の出力部6及び送像系統7をして取り込んで画像処理を行なう画像処理部（通常はパソコンが使用される）を持った視覚認識装置であって、この視覚認識装置5で算出された値を出力する通信ポート8が接続されている。

【0015】上記レーザ正反射CCD変位センサ4は、図2の動作原理図で示すように、樹脂製表皮1における線状溝3の開口部側の斜め上方から微小径の多数のレーザ光  $L_o$  を照射してその反射光  $L_r$  を受光レンズ9を通してCCD10で受信する。このCCD10は、線状溝3の長手方向に直交する方向に等しい間隔で多数の受光素子（周知であるため、図示省略する）が配置されているとともに、その多数の受光素子数を手動で任意に調整可能に構成されており、これら多数の受光素子で反射光  $L_r$  を受光することにより、微小面積の画素が集合した所定幅Wの反射画像を作成する。このCCD10によって作成された画像は上記視覚認識装置5に取り込まれて、そのモニタ画面Mには図3に明示するような画像Pが表示される。

【0016】上記視覚認識装置5の画像処理部は、モニタ画面Mに表示された図3に示す画像Pの画像処理により所定幅Wの中で最も小さな値を溝最深部の値  $t$ （距離）として算出する手段及び樹脂製表皮1の厚み値  $t$ （距離）を算出する手段、その算出された溝最深部の値  $d$  を予め設定入力された溝最深部の最小値  $d_{min}$  及び最大値  $d_{max}$  とそれぞれ比較して算出された溝最深部の値が許容範囲内にあるか否かを判定する手段、樹脂製表皮1の厚み値  $t$  を予め設定入力された最小厚み値  $t_{min}$  と比較して算出された樹脂製表皮1の厚み値  $t$  が設定最小厚み値  $t_{min}$  を超えているか否かを判定する手段、それら両判定手段による判定結果を総合して良品であるか不良品であるかを判定する総合判定手段、不良品と判定されたとき、それに対応する警報を出力する手段、及び、良品と判定されたとき、ファイル名を製作して各算出値  $d$ 、 $t$  を保存する手段とを備えている。

【0017】なお、上記CCD10における受光素子数をモニタ画面M上の画像Pを見ながらその画像に山や谷の部分があるとき、画素数を減少（絞る）する方向に調整することによって、山や谷部分の計測を排除し溝最深部の値  $t$  の計測精度を高めることができる。また、上記画像処理部での総合判定手段による判定結果で良品であると判定されたときは、溝最深部の値  $d$  から線状溝3底部の残存厚み  $T$  が演算処理される。さらに、上記した各

設定値  $d_{min}$ 、 $d_{max}$ 、 $t_{min}$  は上記のモニタ画面M上に数値入力されるものである。

【0018】次に、上記構成の溝深さ計測記録システムを用いて、自動車用樹脂製表皮1のエアバック設置箇所に対応する部分に先行する溝加工装置により切り込み加工された線状溝3の深さ等を計測し記録する方法について、図4のフローチャートを参照して説明する。まず、樹脂製表皮1への線状溝3の加工装置と定盤2の平坦上面2aとの間の設定距離に対応してレーザ正反射CCD変位センサ4におけるCCD10の補正值を設定する補正キャリブレーションを行なった後、レーザ正反射CCD変位センサ4による所定の計測動作を開始する（ステップS21、S22）。

【0019】この計測動作に伴いCCD10の多数の受光素子が反射光  $L_r$  を受光することにより微小面積の画素が集合した所定幅Wの反射画像が作成され、この反射画像が視覚認識装置5に取り込まれるとともに、その反射画像Pの画像処理によって溝最深部の値  $d$  及び表皮1の厚み値  $t$  が距離として算出される（ステップS23、S24）。次いで、その算出溝最深部の値  $d$  と予め設定入力されている最深部最小値  $d_{min}$  及び最大値  $d_{max}$  とがそれぞれ比較されて該算出溝最深部の値  $d$  が設定許容範囲内にあるか否かが判定される（ステップS25、S26）とともに、算出厚み値  $t$  が予め設定入力されている最小厚み値  $t_{min}$  と比較されて該算出厚み値  $t$  が設定最小厚み値  $t_{min}$  を超えているか否かが判定される（ステップS27）。

【0020】そして、上記ステップS25、S26の判定結果がOKであり、かつ、ステップS27の判定結果もOKのアンド条件が成立した場合並びにステップS25、S26、S27の判定結果のいずれかがNGのオア条件が成立した場合、その判定結果及びその時のデータ（各算出値  $d$ 、 $t$ ）を記憶する（ステップS28）。

【0021】次に、記憶された判定結果に基づいて計測動作を続行するか否かが判断されてOKのアンド条件が成立したときは、線状溝3の長手方向に沿い計測位置を移動させて上記したステップでの計測動作を繰り返し続行する一方、NGのオア条件が成立したときは、計測動作を終了する（ステップS29、S30）。

【0022】計測動作が終了したとき、線状溝3の全長に亘る判定結果に基づいて総合判定が行なわれ（ステップS31）、NGの判定結果が一つでもある場合、すなわち、樹脂製表皮1の線状溝3の全長に亘る深さが設定許容範囲外にある部分を含んでいる加工不良の場合及び樹脂製表皮1自体の厚みが設定最小厚み以下の部分を含んでいる厚み不良の場合は、製品（線状溝3が切り込み加工された樹脂製表皮1）が不良品であるとして警報を出力する（ステップS32）一方、全ての判定結果がOKの良品である場合、ファイル名を製作してそのファイル名とともにハードディスクに各算出値  $d$ 、 $t$  及び  $T$  を

7  
保存するとともに、ファイル名のみを通信ポート8に出力する(ステップS33, S34, S35)。

【0023】なお、上記実施の形態では、自動車用エアバッグの設置箇所に対応する部分に所定の肉厚を残存させる状態で線状溝3を切り込み加工する樹脂製表皮1を計測対象としたが、表面上に線状溝を加工するいかなるシート状ワークの溝計測に適用してもよいこともちろんである。

【0024】また、上記実施の形態では、反射画像の画像処理によって溝最深部の値tと同時に表皮1の厚み値tも算出することによって、表皮1の厚みのばらつきに起因する不良品の排除を可能としたもので説明したが、溝最深部の値tのみ算出し、それが設定許容範囲内にあるか否かを判定するだけのものであってもよいこともちろんである。

#### 【0025】

【発明の効果】以上のように、本発明によれば、シート状ワークの表面に切り込み加工された線状溝の溝開口部側からレーザ光を照射してその反射光をCCDの多数の受光素子で受光させることで、等しい微小面積(画素)が集合した所定幅の反射画像を作成し、この反射画像の画像処理によって所定幅の中で最も小さな値を溝最深部の値として算出することで、線状溝が許容される範囲内で多少蛇行状態に加工されていたとしても、また、シート状ワークの材質に関係なく、溝最深部の値及びそれに応する残存厚みをミスなく確実に計測し記録することができる。したがって、その記録データを次に線状溝を再現性よく加工するためのフィードバック資料に有効利\*

\*用いて、製品全体の品質管理に役立てることができる。  
【0026】加えて、レーザ光の反射光を受信するものであって、投光部も受光部もシート状ワークの表面側に配置して、つまり、シート状ワークの裏面を定盤などの平坦面に密着固定させて表面に溝を加工する溝加工装置側に計測装置の全体を近接配置して溝加工と並行して溝深さを計測することができ、これによって、溝加工及び加工溝深さの計測を一連の工程で能率よく行なえ、製品の生産性の向上にも資することができるという効果を奏する。

#### 【図面の簡単な説明】

【図1】本発明に係る溝深さ計測記録方法の実施に際して用いられる自動車用樹脂製表皮の溝深さ計測記録システムの概略構成図である。

【図2】同上システムにおける主要部であるレーザ正反射CCD変位センサの動作原理図である。

【図3】同上システムにおける主要部である視覚認識装置に画像表示されたモニタ画面の説明図である。

【図4】自動車用樹脂製表皮に切り込み加工された線状溝の深さ等を計測・記録処理する動作を示すフローチャートである。

#### 【符号の説明】

1 自動車用樹脂製表皮(シート状ワークの一例)

2 定盤

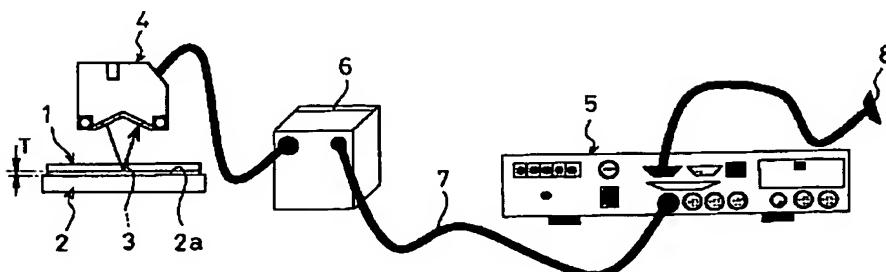
3 線状溝

4 レーザ正反射CCD変位センサ

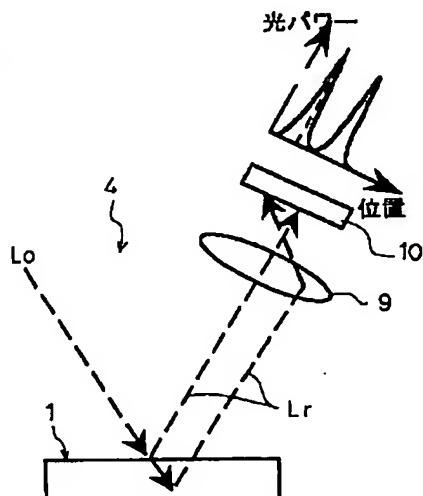
5 視覚認識装置(画像処理装置の一例)

10 CCD

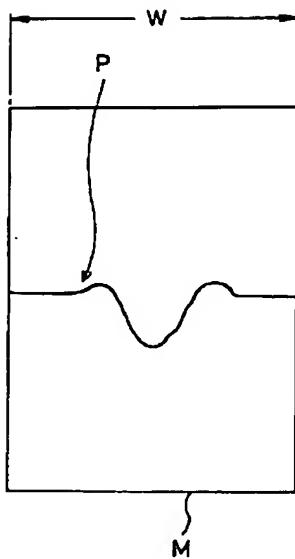
【図1】



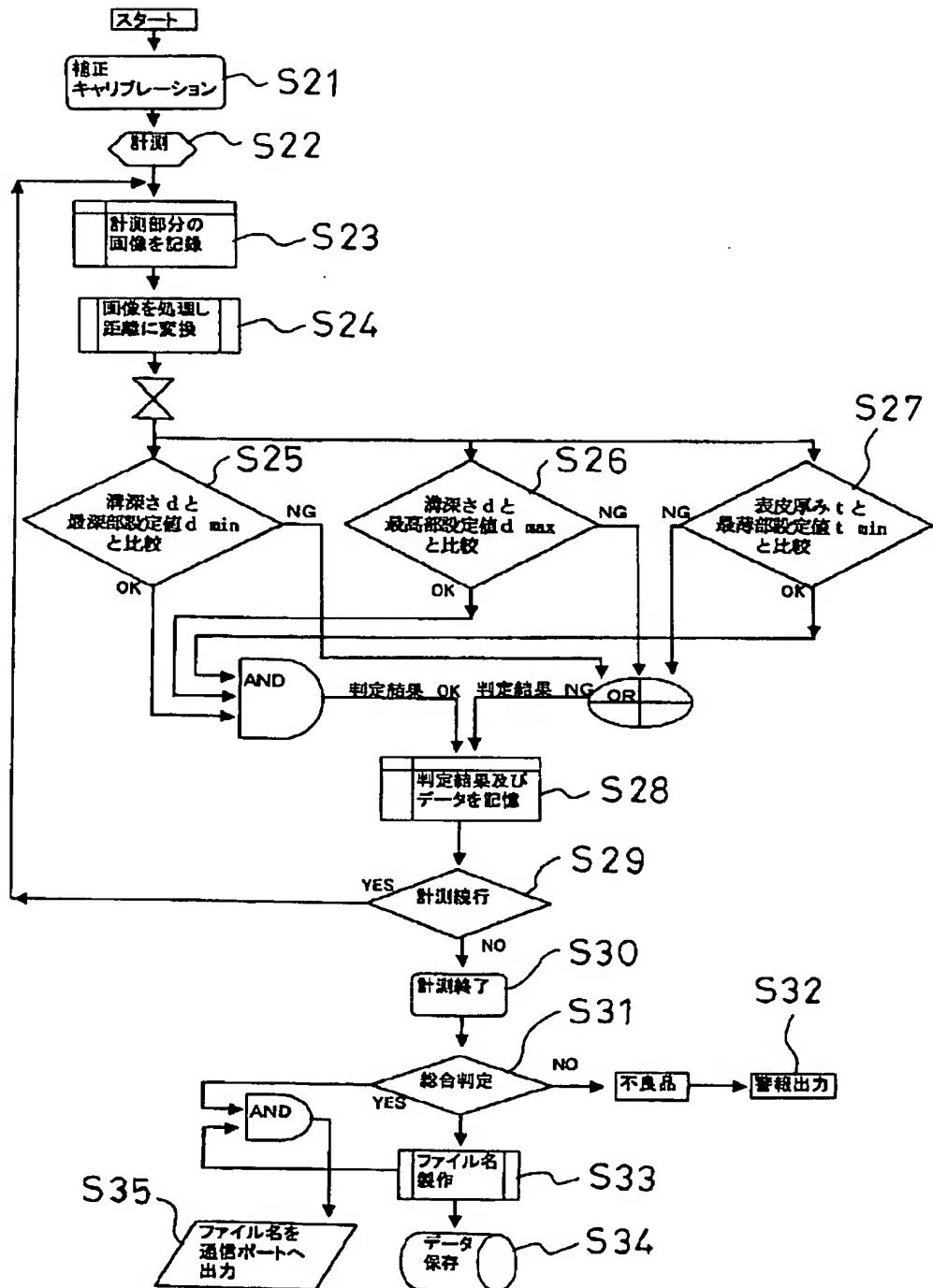
【図2】



【図3】



【図4】



フロントページの続き

F ターム(参考) 2F065 AA25 AA30 CC02 FF04 GG04  
HH12 JJ02 JJ25 MM06 NN12  
QQ25 QQ31 SS13  
3D054 AA02 AA03 AA04 AA13 AA14  
AA18 BB02 BB09 BB23

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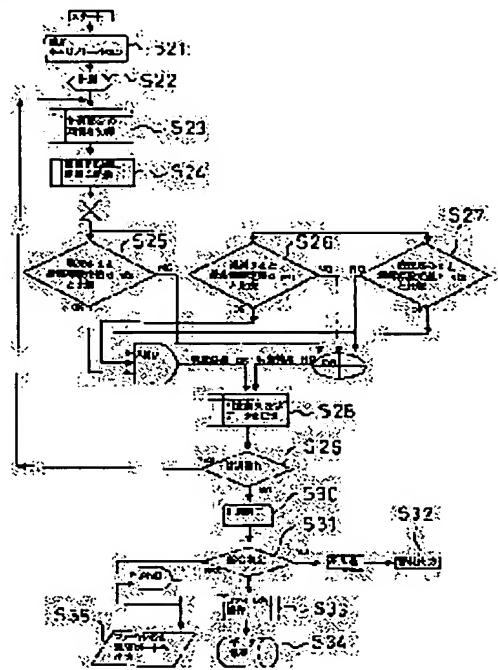
(72)Inventor : IGAWA MIKIHIRO

## (54) GROOVE DEPTH-MEASURING/RECORDING METHOD AND SYSTEM

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To efficiently measure a remaining thickness at the bottom section of a linear groove in parallel with groove machining and at the same time to perform accurate quality control by reliably and accurately measuring and recording the remaining thickness corresponding to the deepest section in the groove even if the linear groove is slightly zigzag.

**SOLUTION:** A linear groove that is cut and machined on the surface of a cover made of resin is irradiated with laser beams from its opening side, and the reflection light is received and outputted by a number of light receiving elements to create a reflection image having a specific width. Calculation is made with the smallest value in the specific width as the value of the deepest value in the groove by the image processing of the reflection image. It is judged whether the calculated value of the deepest section in the groove is within a tolerance setting range or not. Then, only when all the judgment results are good, only the remaining thickness is calculated and outputted from the deepest section in the groove and is recorded.



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CLAIMS

## [Claim(s)]

[Claim 1] The depth of flute is measured. the line cut deeply and processed on the front face of a sheet-like work piece -- It is the approach of carrying out an operation output and recording the residual thickness of the groove bottom section. the line in the sheet-like work piece from the measurement value -- the line of the sheet-like work-piece front face by which fixed maintenance was carried out so that a rear face might stick to a flat side, while irradiating the laser beam turned to a slot from an opening side at the groove bottom section The reflective image of predetermined width of face with which it received by CCD which has many photo detectors at spacing equal to the direction which intersects perpendicularly with the longitudinal direction of a slot, and much minute area gathered is created. the reflected light -- a line -- After computing the smallest value in predetermined width of face as a value of the deepest part of the groove by carrying out the image processing of the reflective image created by this CCD, Judge whether it is in the tolerance where the computed deepest-part-of-the-groove value was set up beforehand, and it is set to the judgment. The channel depth measurement record approach characterized by recording the output value while carrying out the operation output of the residual thickness from a calculation deepest-part-of-the-groove value, when a judgment result that the above-mentioned calculation deepest-part-of-the-groove value is in setting tolerance comes out.

[Claim 2] the condition that the target sheet-like work piece makes predetermined thickness remain into the part corresponding to an air bag installation part -- a line -- the channel depth measurement record approach according to claim 1 which is the resin tabulation hide for automobiles into which a slot is cut deeply and processed.

[Claim 3] The depth of flute is measured. the line cut deeply and processed on the front face of a sheet-like work piece -- the line in the sheet-like work piece from the measurement value -- with the surface plate which carries out fixed maintenance so that it may be the system which carries out an operation output and records the residual thickness of the groove bottom section and the rear face may stick a sheet-like work piece to a flat side the line of a sheet-like work-piece front face, while irradiating a laser beam from the opening side of a slot the reflected light -- a line -- with CCD which creates the reflective image of predetermined width of face with which minute area gathered by receiving light by the photo detector of a large number arranged at spacing equal to the direction which intersects perpendicularly with the longitudinal direction of a slot A means to compute the smallest value in predetermined width of face as a value of the deepest part of the groove by the image processing of the reflective image created by this CCD, In a judgment means to judge whether it is in the tolerance where that computed deepest-part-of-the-groove value was set up beforehand, and this judgment means The channel depth measurement record system characterized by providing a means to record the output value while carrying out the operation output of the residual thickness from the above-mentioned calculation deepest-part-of-the-groove value, when a judgment result that the above-mentioned calculation deepest-part-of-the-groove value is in setting tolerance comes out.

[Claim 4] The light-receiving element number in Above CCD is a channel depth measurement record system according to claim 1 constituted manually possible [ adjustment ].

[Claim 5] the condition that the target sheet-like work piece makes predetermined thickness remain into the part corresponding to an air bag installation part -- a line -- the channel depth measurement record system according to claim 3 or 4 which is the resin tabulation hide for automobiles into which a slot is cut deeply and processed.

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[Translation done.]

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Field of the Invention] Vinyl chloride (PVC) and polyolefine (TPO) with which this invention mainly forms the instrument panel for automobiles. When the destructive power more than fixed joins the part corresponding to the air bag installation part of resin tabulation hides, such as polyurethane (TPU), the line which is made to concentrate stress on the part, fractures certainly, and enables an air bag's proper expansion -- like a slot the line cut deeply and processed on the predetermined part of a sheet-like work piece -- a line [ in / the depth of flute is measured and / the sheet-like work piece from the measurement value ] -- it is related with the approach of measuring and recording the residual thickness of the groove bottom section, and its system.

#### [0002]

[Description of the Prior Art] a sheet-like work piece -- a line -- when managing the product quality proper in the product which cuts a slot deeply, processes it and is produced -- a line -- it is important to measure the residual thickness of the groove bottom section, to record as data for every product and to save. the line especially processed into the part corresponding to the air bag installation part of the resin tabulation hide for automobiles -- the line which have fixed destructive resistance from a slot be what participate in a passenger's safety closely -- in order to process the groove bottom section with sufficient repeatability -- a line -- it be very important to measure the residual thickness of the groove bottom section with a sufficient precision , and to record and save the data for every product .

[0003] the line generally conventionally cut deeply and processed into the front-face side of a sheet-like work piece -- a means to measure residual thickness was adopted by irradiating light towards the groove bottom section from the opening side of a slot, and measuring the amount of transmitted lights by the side of a work-piece rear face.

#### [0004]

[Problem(s) to be Solved by the Invention] however , with the measurement means of the light transmission mold like the above , a slot be in tolerance along with the longitudinal direction , since it be difficult to always pinpoint the exposure location of light in the deepest part of the groove and an exposure location not only tend to shift from the deepest part , but tend to change the amount of transmitted lights sharply by quality of the material change of a work piece when process meanderingly , it be easy to produce an error at the measurement value of residual thickness , and accurate quality control cannot be perform .

[0005] Moreover, since it is required to arrange the floodlighting section and a light sensing portion on front flesh-side both sides of a sheet-like work piece at each \*\* in the case of the measurement means of a light transmission mold A metering device cannot be arranged to the one direction by the side of the recessing equipment which carries out adhesion immobilization of the sheet-like work piece which is a candidate for processing in the flat side of a surface plate etc., and performs recessing. It measured in the part left with the recessing part, or it was necessary to measure at separated another process with a recessing process, while being easy to become complicated in equipment, the process increased, and there was a problem that productivity got worse.

[0006] that by which this invention was made in view of the above-mentioned actual condition -- it is -- a line -- the residual thickness of the groove bottom section -- recessing -- being concurrent -- being well measurable not only but a line -- even if a slot lies in a zigzag line somewhat and is processed, it aims at offering the channel depth measurement record approach that the residual thickness corresponding to the deepest part of the groove can be measured certainly and with high precision, and can be recorded, and it can use for accurate quality control, and its system.

#### [0007]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the channel depth

measurement record approach concerning this invention. The depth of flute is measured. the line cut deeply and processed on the front face of a sheet-like work piece -- It is the approach of carrying out an operation output and recording the residual thickness of the groove bottom section. the line in the sheet-like work piece from the measurement value -- the line of the sheet-like work-piece front face by which fixed maintenance was carried out so that a rear face might stick to a flat side, while irradiating the laser beam turned to a slot from an opening side at the groove bottom section. The reflective image of predetermined width of face with which it received by CCD which has many photo detectors at spacing equal to the direction which intersects perpendicularly with the longitudinal direction of a slot, and much minute area gathered is created. the reflected light -- a line -- After computing the smallest value in predetermined width of face as a value of the deepest part of the groove by carrying out the image processing of the reflective image created by this CCD, Judge whether it is in the tolerance where the computed deepest-part-of-the-groove value was set up beforehand, and it is set to the judgment. When a judgment result that the above-mentioned calculation deepest-part-of-the-groove value is in setting tolerance comes out, while carrying out the operation output of the residual thickness from a calculation deepest-part-of-the-groove value, it is characterized by recording the output value.

[0008] Moreover, the channel depth measurement record system concerning this invention. The depth of flute is measured. the line cut deeply and processed on the front face of a sheet-like work piece -- the line in the sheet-like work piece from the measurement value -- with the surface plate which carries out fixed maintenance so that it may be the system which carries out an operation output and records the residual thickness of the groove bottom section and the rear face may stick a sheet-like work piece to a flat side the line of a sheet-like work-piece front face, while irradiating a laser beam from the opening side of a slot the reflected light -- a line -- with CCD which creates the reflective image of predetermined width of face with which minute area gathered by receiving light by the photo detector of a large number arranged at spacing equal to the direction which intersects perpendicularly with the longitudinal direction of a slot. A means to compute the smallest value in predetermined width of face as a value of the deepest part of the groove by the image processing of the reflective image created by this CCD, In a judgment means to judge whether it is in the tolerance where that computed deepest-part-of-the-groove value was set up beforehand, and this judgment means When a judgment result that the above-mentioned calculation deepest-part-of-the-groove value is in setting tolerance comes out, while carrying out the operation output of the residual thickness from the above-mentioned calculation deepest-part-of-the-groove value, it is characterized by providing a means to record the output value.

[0009] the line which according to this invention which has the requirements for a configuration like the above fixed maintenance was carried out, and was cut deeply and processed on the sheet-like work piece front face so that a rear face might stick to a flat side -- the reflective image of predetermined width of face with which equal minute area ( pixel) gathered will be created by irradiating a laser beam from the slot opening side of a slot, and making the reflected light receive by many photo detectors of CCD. thus, the thing for which the smallest value in predetermined width of face is computed as a value of the deepest part of the groove by the image processing of the reflective image created by predetermined width of face -- a line -- though some were processed into the meandering condition within limits by which a slot is permitted, it is possible to measure certainly without a mistake of the value of the deepest part of the groove. Moreover, by judging whether it is in the tolerance where the value of the measured deepest part of the groove was set up beforehand, calculating residual thickness, and outputting and recording it, only when the judgment result is O.K. measuring the residual thickness corresponding to the deepest part of the groove with a sufficient precision, and recording it regardless of the quality of the material of the sheet-like work piece itself, -- possible -- the record data -- a degree -- a line -- by using a slot for the feedback data for processing it with sufficient repeatability. It is possible to control quality the quality of the whole product accurately.

[0010] Moreover, since the reflected light of a laser beam can be received, the floodlighting section and a light sensing portion can be arranged to a sheet-like work-piece front-face side and it can measure from an one direction. It becomes possible to carry out contiguity arrangement of the whole metering device at the recessing equipment side which the flat side of a surface plate etc. is made to carry out adhesion immobilization of the rear face of a sheet-like work piece, and processes a slot on a front face, and to measure a channel depth in parallel to recessing. Measurement of recessing and a processing channel depth can be well performed at a series of processes, and the productivity drive of a product can also be planned.

[0011] In the channel depth measurement record system concerning above-mentioned this invention, the light-receiving element number in CCD, i.e., the number of pixels, like, when [ according to claim 4 ] it constitutes manually possible [ adjustment ] When the parts of a crest or a trough are in the image, looking at an image, by adjusting the number of pixels in the direction which decrease in number (it extracts), it becomes possible to eliminate a crest and measurement for a trough, and the measurement precision of the value of the deepest part

can be raised further.

[0012] moreover, a target sheet [ system / the channel depth measurement record concerning this invention, and / its ]-like work piece -- a front face -- a line -- the condition make predetermined thickness remain into the part corresponding to an air bag installation part as indicate to claim 2 and claim 5 although it be anything as long as it be the sheet-like thing into which the slot be processed -- a line -- it be effective especially when aim at the resin tabulation hide for automobiles into which a slot cut deeply and be process. the line as which being processed in a very small error range from the field of safety reservation of the passenger of an automobile called the expansion engine performance of an air bag when aimed at this resin tabulation hide for automobiles is required -- the processing depth of a slot can be measured correctly, and can be recorded and it can utilize effective in creation of the feedback data for performing recessing with sufficient repeatability.

[0013]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. Drawing 1 is the outline block diagram of the channel depth measurement record system used in case this invention approach is enforced by using the resin tabulation hide for automobiles as an object sheet-like work piece. the condition 1 is the resin tabulation hide for automobiles laid so that the rear face might stick to flat top-face 2a of a surface plate 2 in this drawing, and make the thickness of predetermined thickness t remain at the pars basilaris ossis occipitalis in the part corresponding to an air bag installation part on the front face with various kinds of recessing equipments (for an illustration abbreviation to be carried out), such as for example, ultrasonic-machining equipment, and laser-beam-machining equipment or high-frequency-processing equipment, -- a line -- a slot 3 cuts deeply and is processed.

[0014] the laser specular reflection CCD by which 4 was installed in the upper part section of the front face of the above-mentioned resin tabulation hide 1 -- a variation rate -- it is a sensor, and this is installed so that it may move in one with recessing equipment. 5 -- that laser specular reflection CCD -- a variation rate -- it is visual-recognition equipment with the image-processing section (a personal computer is usually used) which captures the CCD receiving image of a sensor 4 through the output section 6 and the \*\*\*\* network 7 of NTSC system, and performs an image processing, and the communication link port 8 which outputs the value computed with this visual-recognition equipment 5 is connected.

[0015] the above-mentioned laser specular reflection CCD -- a variation rate -- a line [ in / as a sensor 4 shown in the principle-of-operation Fig. of drawing 2 / the resin tabulation hide 1 ] -- many laser beams Lo of the diameter of minute are irradiated from the slanting upper part by the side of opening of a slot 3, and the reflected light Lr is received by CCD10 through the light-receiving lens 9. this CCD10 -- a line -- while many photo detectors (an illustration abbreviation is carried out since it is common knowledge) are arranged at spacing equal to the direction which intersects perpendicularly with the longitudinal direction of a slot 3, arbitration constitutes the light-receiving element number of those large number possible [ adjustment ] manually, and the reflective image of the predetermined width of face W with which the pixels of minute area gathered is created by receiving the reflected light Lr by the photo detector of these large number. The image created by this CCD10 is captured by the above-mentioned visual-recognition equipment 5, and the image P which is specified in drawing 3 is displayed on that monitor display M.

[0016] A means to compute the thickness value t (distance) of a means to compute the smallest value in the predetermined width of face W as a value t of the deepest part of the groove (distance) by the image processing of the image P which shows the image-processing section of the above-mentioned visual-recognition equipment 5 to drawing 3 displayed on monitor display M, and the resin tabulation hide 1, A means to judge whether the value of the deepest part of the groove computed in the value d of the computed deepest part of the groove [ the minimum value dmin of the deepest part by which the setting input was carried out beforehand, and Maximum dmax / respectively ] is in tolerance, A means to judge whether the thickness value t of the resin tabulation hide 1 computed in the thickness value t of the resin tabulation hide 1 as compared with the minimum thickness value tmin by which the setting input was carried out beforehand is over the setting minimum thickness value tmin, When judged with a means to output the alarm corresponding to it when judged with the comprehensive judgment means and defective which synthesize the judgment result by both [ these ] the judgment means, and judge whether it is an excellent article or it is a defective, and an excellent article, it has a means to manufacture a file name and to save each calculation values d and t.

[0017] In addition, when the parts of a crest or a trough are in the image about the light-receiving element number in the above CCD 10, looking at the image P on monitor display M, by adjusting the number of pixels in the direction which decrease in number (it extracts), a crest and measurement for a trough can be eliminated and the measurement precision of the value t of the deepest part of the groove can be raised. moreover, the time of being judged with it being as a result of [ by the comprehensive judgment means in the above-mentioned image-processing section ] a judgment, and being an excellent article -- the line from the value d of the deepest

part of the groove -- data processing of the residual thickness T of slot 3 pars basilaris ossis occipitalis is carried out. Furthermore, the numerical input of each above-mentioned set points dmin, dmax, and tmin is carried out on the above-mentioned monitor display M.

[0018] next, the line which cut deeply with the recessing equipment preceded with the part corresponding to the air bag installation part of the resin tabulation hide 1 for automobiles, and was processed using the channel depth measurement record system of the above-mentioned configuration -- how to measure and record the depth of a slot 3 etc. is explained with reference to the flowchart of drawing 4. first, the line to the resin tabulation hide 1 -- the setting distance between the processing equipment of a slot 3, and flat top-face 2a of a surface plate 2 -- corresponding -- the laser specular reflection CCD -- a variation rate -- the laser specular reflection CCD after performing the amendment calibration which sets up the correction value of CCD10 in a sensor 4 -- a variation rate -- the predetermined measurement actuation by the sensor 4 is started (steps S21 and S22).

[0019] While the reflective image of the predetermined width of face W with which the pixels of minute area gathered when many photo detectors of CCD10 received the reflected light Lr with this measurement actuation is created and this reflective image is captured by visual-recognition equipment 5, the value d of the deepest part of the groove and the thickness value t of epidermis 1 are computed by the image processing of that reflective image P as a distance (steps S23 and S24). subsequently, whether the deepest part minimum value dmin by which the setting input is beforehand carried out with the value d of the calculation deepest part of the groove, and Maximum dmax are compared, respectively, and the value d of this calculation deepest part of the groove is in setting tolerance judges -- having (steps S25 and S26) -- It is judged whether it is compared with the minimum thickness value tmin by which the setting input of the calculation thickness value t is carried out beforehand, and this calculation thickness value t is over the setting minimum thickness value tmin (step S27).

[0020] And the judgment result of the above-mentioned steps S25 and S26 is O.K., and the judgment result of step S27 is also O.K., and when conditions are satisfied, either of the judgment results of steps S25, S26, and S27 is NG at a list, or when conditions are satisfied, the judgment result and the data at that time (each calculation values d and t) are memorized (step S28).

[0021] next, whether measurement actuation is continued based on the memorized judgment result judges -- having -- O.K. -- and the time of conditions being satisfied -- a line -- while repeating and continuing measurement actuation at the step which was made to move a measurement location along with the longitudinal direction of a slot 3, and was described above -- NG -- or when conditions are satisfied, measurement actuation ends (steps S29 and S30).

[0022] A comprehensive judgment is performed based on the judgment result covering the overall length of a slot 3 (step S31). the time of measurement actuation being completed -- a line -- the line of the resin tabulation hide 1 when the number of the judgment results of NG is also one -- the case of the poor thickness in which the case of poor processing containing the part which has the depth covering the overall length of a slot 3 outside setting tolerance, and the thickness of resin tabulation hide 1 the very thing contain the part below the setting minimum thickness an alarm is outputted noting that a product (line resin tabulation hide 1 into which the slot 3 cut deeply and was processed) is a defective -- on the other hand (step S32) When all judgment results are the excellent articles of O.K., while manufacturing a file name and saving each calculation values d, t, and T with the file name at a hard disk, only a file name is outputted to the communication link port 8 (steps S33, S34, and S35).

[0023] in addition, the condition of making predetermined thickness remaining into the part corresponding to the installation part of the air bag for automobiles with the gestalt of the above-mentioned implementation -- a line -- although the resin tabulation hide 1 into which a slot 3 is cut deeply and processed was made applicable to measurement -- a front face top -- a line -- you may apply to the slot measurement of what kind of sheet-like work piece which processes a slot -- it is natural.

[0024] moreover, you may be only what judges whether only the value t of the deepest part of the groove is computed, and it is in setting tolerance although it is what was made possible and exclusion of the defective which originates in dispersion in the thickness of epidermis 1 by computing the value t of the deepest part of the groove, simultaneously the thickness value t of epidermis 1 by the image processing of a reflective image was explained with the gestalt of the above-mentioned implementation -- it is natural.

[0025]

[Effect of the Invention] as mentioned above, the line which was cut deeply and processed on the front face of a sheet-like work piece according to this invention -- by irradiating a laser beam from the slot opening side of a slot, and making the reflected light receive by many photo detectors of CCD By creating the reflective image of predetermined width of face with which equal minute area (pixel) gathered, and computing the smallest value in predetermined width of face as a value of the deepest part of the groove by the image processing of this

reflective image a line -- though some were processed into the meandering condition within limits by which a slot is permitted, regardless of the quality of the material of a sheet-like work piece, the value of the deepest part of the groove and the residual thickness corresponding to it can be measured certainly without a mistake, and can be recorded. therefore, the record data -- a degree -- a line -- it can use effectively for the feedback data for processing a slot with sufficient repeatability, and can use for quality control of the whole product.

[0026] In addition, receive the reflected light of a laser beam and the floodlighting section and a light sensing portion are arranged to the front-face side of a sheet-like work piece. Contiguity arrangement of the whole metering device can be carried out at the recessing equipment side which the flat side of a surface plate etc. is made to carry out adhesion immobilization of the rear face of a sheet-like work piece, and processes a slot on a front face, and a channel depth can be measured in parallel to recessing. That is, by this Measurement of recessing and a processing channel depth can be well performed at a series of processes, and the effectiveness that it can \*\* also to improvement in the productivity of a product is done so.

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

[Drawing 1] It is the outline block diagram of the channel depth measurement record system of the resin tabulation hide for automobiles used on the occasion of operation of the channel depth measurement record approach concerning this invention.

[Drawing 2] the laser specular reflection CCD which is the principal part in a system same as the above -- a variation rate -- it is the principle-of-operation Fig. of a sensor.

[Drawing 3] It is the explanatory view of the monitor display by which image display was carried out to the visual-recognition equipment which is the principal part in a system same as the above.

[Drawing 4] the line cut deeply and processed into the resin tabulation hide for automobiles -- it is the flow chart which shows the actuation which carries out measurement / record processing of the depth of flute etc.

**[Description of Notations]**

1 Resin Tabulation Hide for Automobiles (an Example of Sheet-like Work Piece)

2 Surface Plate

3 Line -- Slot

4 Laser Specular Reflection CCD Displacement Sensor

5 Visual-Recognition Equipment (an Example of Image Processing System)

10 CCD

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[Translation done.]

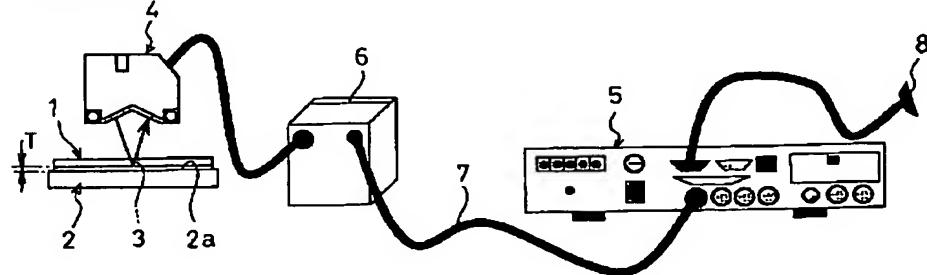
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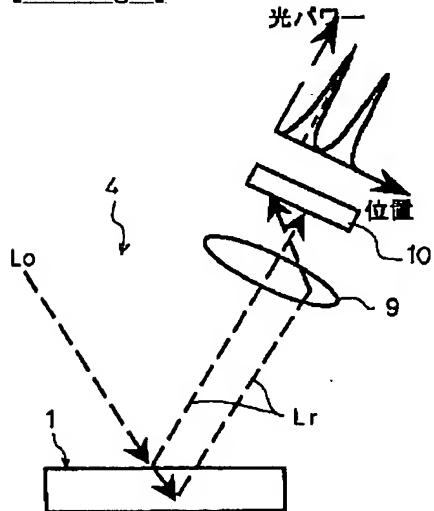
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## DRAWINGS

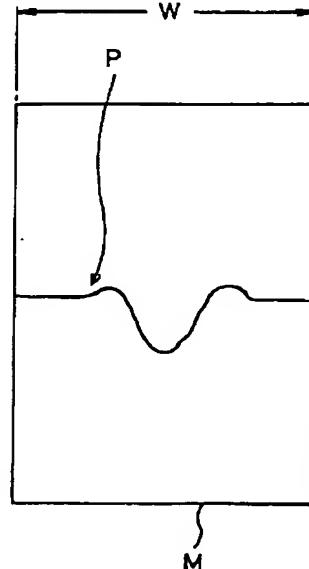
[Drawing 1]



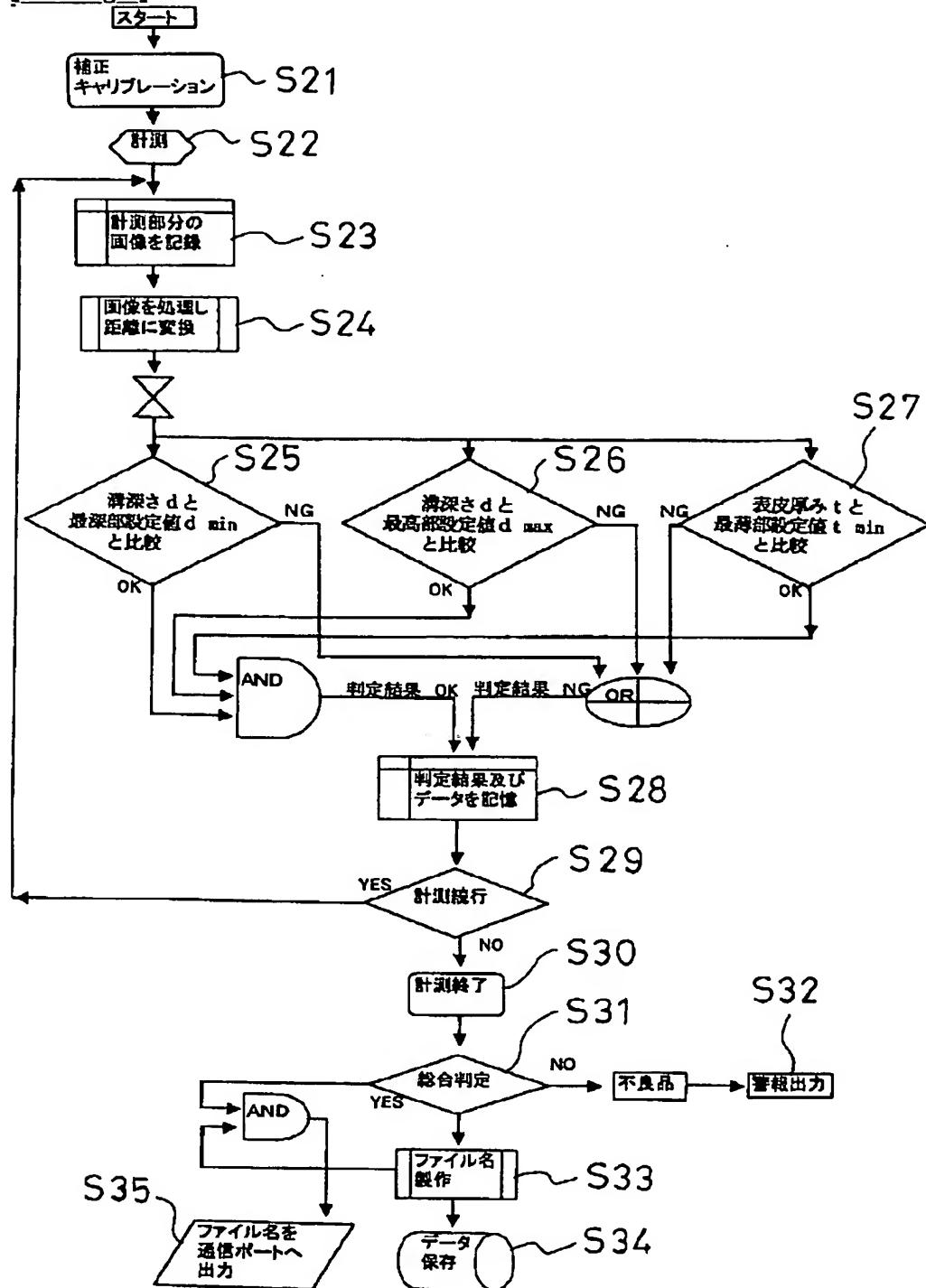
[Drawing 2]



[Drawing 3]



## [Drawing 4]



[Translation done.]

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